

Memorandum

To: Chris Hempleman
Cc: Brian Zalewsky, Mike LeMoine, Dustin Bilhimer, Trevor Swanson, Kirk Sinclair, Lawrence Sullivan, Greg Pelletier
From: Mindy Roberts
Date: February 9, 2003
Subject: Deschutes River, Capitol Lake, Budd Inlet TMDL
Quarterly Progress Report #3 (October through December 2003)

Introduction

The Deschutes River, Capitol Lake, Budd Inlet, and tributaries were placed on the 1996 and/or 1998 Clean Water Act Section 303(d) list of impaired waters based on historical monitoring by several organizations. In total, 24 waterbodies have water quality parameter levels that do not meet standards for at least one of the following: temperature, fecal coliform bacteria, dissolved oxygen, pH, nutrients, or fine sediment. The TMDL study began in March 2003 to assess the current condition of the waterbodies and to identify and quantify factors contributing to the impairments. The previous quarterly progress reports (July 31, 2003 and December 1, 2003) summarized the results of the reconnaissance monitoring program through September 2003.

This memorandum summarizes the progress to date related to data collection and project communications. Data presented are provisional; data quality has not been checked.

Progress to Date

Temperature and Hydrogeology Data Collection

The previous quarterly report summarized summer and fall 2003 surface water temperature data. Surface water temperature probes were removed in October 2003.

On November 30, 2003, Ecology received a preliminary report for the airborne thermal infrared (TIR) remote sensing survey on the Deschutes River that was conducted on August 19, 2003, by Watershed Sciences, LLC. The objective of the project was to collect TIR and color video imagery in order to characterize the thermal regime of the river. The imagery and analysis support the temperature portion of the Deschutes-Budd Inlet TMDL study.

The river was flown upstream from Capitol Lake to Deschutes Falls, a distance of approximately 42 miles (68 km) (Figure 1). Images were collected with TIR (8-12 μ m) and visible-band cameras attached to a gyro-stabilized mount on the underside of a helicopter. The two sensors were aligned to present the same ground area, and the helicopter was flown longitudinally along the stream channel with the sensor looking straight down. Thermal infrared images were recorded directly from the sensor to an on-board computer in a format in which each pixel contained a measured radiance value.

Measured radiance values contained in the raw TIR images were converted to temperatures based on the emissivity of water, atmospheric transmission effects, ambient background reflections, and the calibration characteristics of the sensor. Once the TIR images were calibrated, they were integrated into a GIS in which an analyst interpreted and sampled stream temperatures.

The report contains thermal infrared and associated true color video images that illustrate significant thermal features (Figure 2). An associated ArcView 3.2 GIS database includes all of the images collected during the survey and is structured to allow for analysis at finer scales. The report also contains a longitudinal temperature profile showing the patterns of warming and cooling in relation to the distance from the stream mouth (Figure 3). The images will be available on a website in February 2004.

The TIR images represent a significant data source in the stream temperature monitoring and analysis program in the Deschutes River. Thermal imagery will be used to detect and quantify warm and cool water sources, calibrate the stream temperature model, and identify thermal processes. TIR imagery also will be applied in the mapping of groundwater inflows and analysis of floodplain hydrology. These remotely sensed data will provide a spatially continuous map of temperatures within the watershed and complement the temporally continuous, but spatially limited, point monitors placed in the study area.

Conventional Water Quality Parameter Data Collection

Routine monitoring continued through December. Samples were collected from the Deschutes River, Capitol Lake, their tributaries, and tributaries to Budd Inlet twice monthly in October and monthly in November and December 2003 and analyzed for fecal coliform bacteria. From July through December 2003, 12 sites had concentrations greater than 200/100 mL on at least one occasion: Adams, Ayer, Black Lake Ditch, Butler, Capitol Lake, Ellis, Indian, Mission, Moxlie, Percival, Reichel, and Spurgeon creeks. Table 1 presents fecal coliform data collected to date.

Table 2 presents nutrient and related laboratory data. Nitrogen levels are relatively high throughout the mainstem Deschutes River. Lower levels in Capitol Lake likely reflect productivity. Alkalinity varied from 40 near the upper falls to 50 at the E Street bridge from July through October. As discharge increased with rainfall runoff, the alkalinity decreased. However, the Deschutes River maintained a longitudinal gradient from the upper falls to the E Street bridge. Organic carbon levels were low in the fall but increased in mid-October. Nearly all the organic carbon is dissolved.

Dissolved oxygen levels consistently fall below 8 mg/L at Ayer and Reichel creeks, as shown in Table 3. The tributary downstream of Lake Lawrence also experiences low DO. DO levels at all other locations were above 8 mg/L. Only Ayer Creek had instantaneous pH levels that do not meet the water quality standards.

Dissolved oxygen at the outlet from Capitol Lake was monitored continuously in late October. Minimum DO levels met the water quality standard, as shown in Figure 4. Diel swings in DO levels varied from 1 to 3 mg/L.

Ten stormwater outfalls were visited on October 14, 2003. Seven were dry, and the three with flowing water had fecal coliform levels less than 30 per 100 mL, as shown in Table 4.

Communication and Coordination

- Presented overview of TMDL study to the Capitol Lake Adaptive Management Plan committee October 2, 2003.

- Discussed bathymetric survey equipment with Ecology SEA Program and with USGS staff. Discussed using GA boat with fathometer for survey with Steve Morrison (Thurston Regional Planning Council) December 10, 2003.
- Discussed WDOT monitoring in the Indian Creek watershed with Cynthia Stonick (Ecology Water Quality Program).
- Distributed Quarterly Progress Report #2 December 1, 2003 via e-mail to the Technical Advisory Group.
- Completed internal Ecology draft of the calendar year 2004 QAPP. Distributed draft QAPP to external reviewers November 24, 2003. Met with Deschutes Technical Advisory Group December 15, 2003 to discuss QAPP. Compiled comments and revised draft QAPP. Discussed response to comments with Roy Iwai (Olympia), Tom Clingman (Thurston County), Rich Eltrich (WDFW), and Sue Davis (Thurston County) on December 22 and 23, 2003.
- Discussed scope of Centennial Fund grant with Thurston County staff.
- Discussed WSDOT involvement with Steve Thompson (WSDOT) December 4, 2003.
- Discussed scope of bathymetric survey relative to estuary feasibility study needs with Bob Barnard (WDFW) December 4 and December 8.
- Provided interim Deschutes data to Joanne Schuett-Hames December 10, 2003 to update the WRIA 13 limiting factors analysis to assist with strategy development for the Salmon Recovery Funding Board.
- Discussed options for aerial photo of Capitol Lake to coincide with bathymetric survey with Steve Morrison (Thurston Regional Planning Council), Andrew Kinney (Thurston County GeoData Center), and Scott Smith (David Smith & Associates) December 23, 2003.
- Discussed WDFW hatchery operations with Greg Cloud (Ecology Water Quality Program).
- Discussed scope of 2004 stream temperature sampling and groundwater monitoring program with Tom Clingman and Bob Mead (Thurston County).

Project Schedule and Upcoming Tasks

Ecology completed the reconnaissance monitoring program in December 2003. The QAPP for calendar year 2004 monitoring has been finalized and will be available in February 2004. Routine monitoring began in mid-January.

Figures and Tables

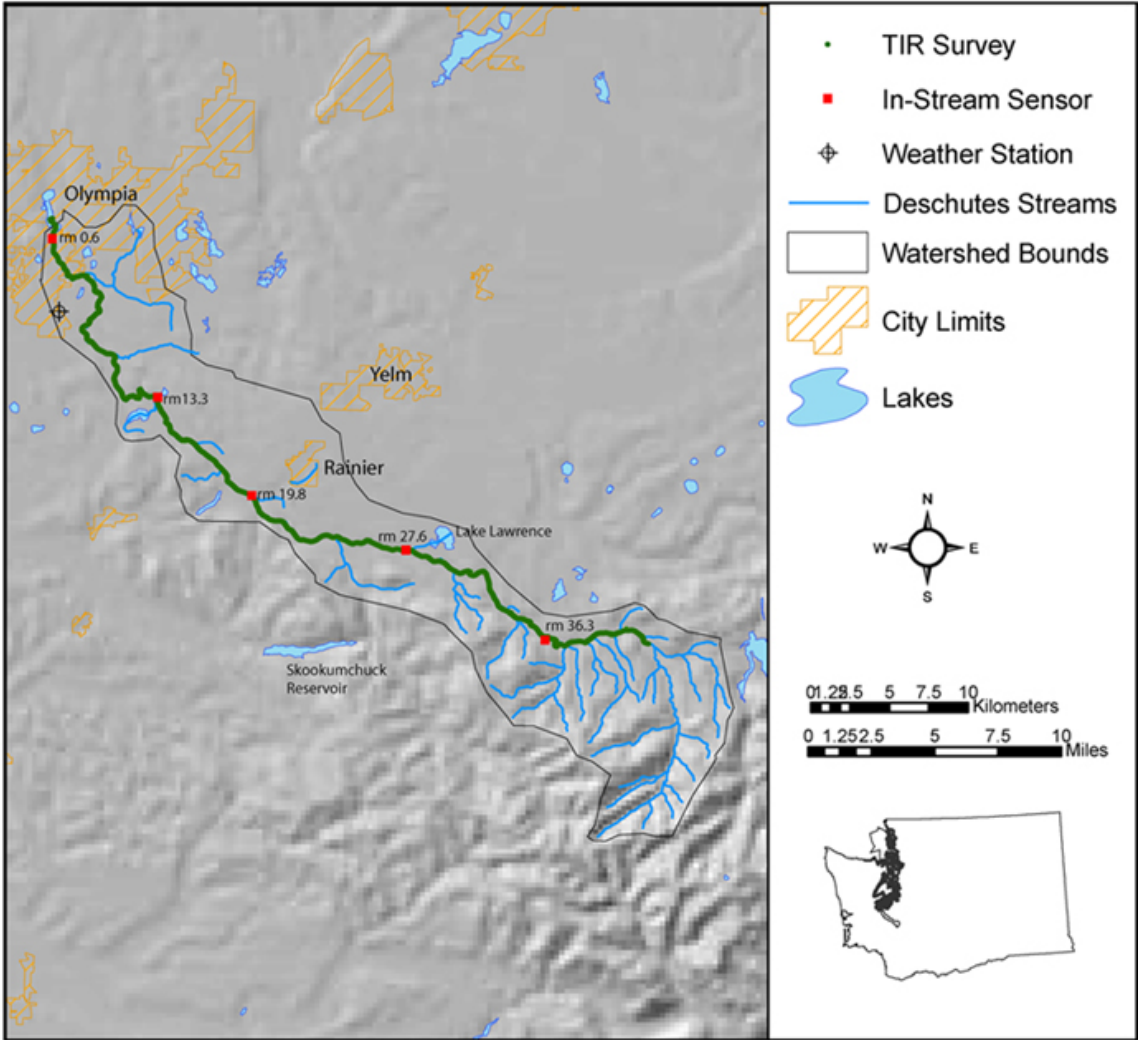


Figure 1. Extent of the airborne TIR on the Deschutes River.

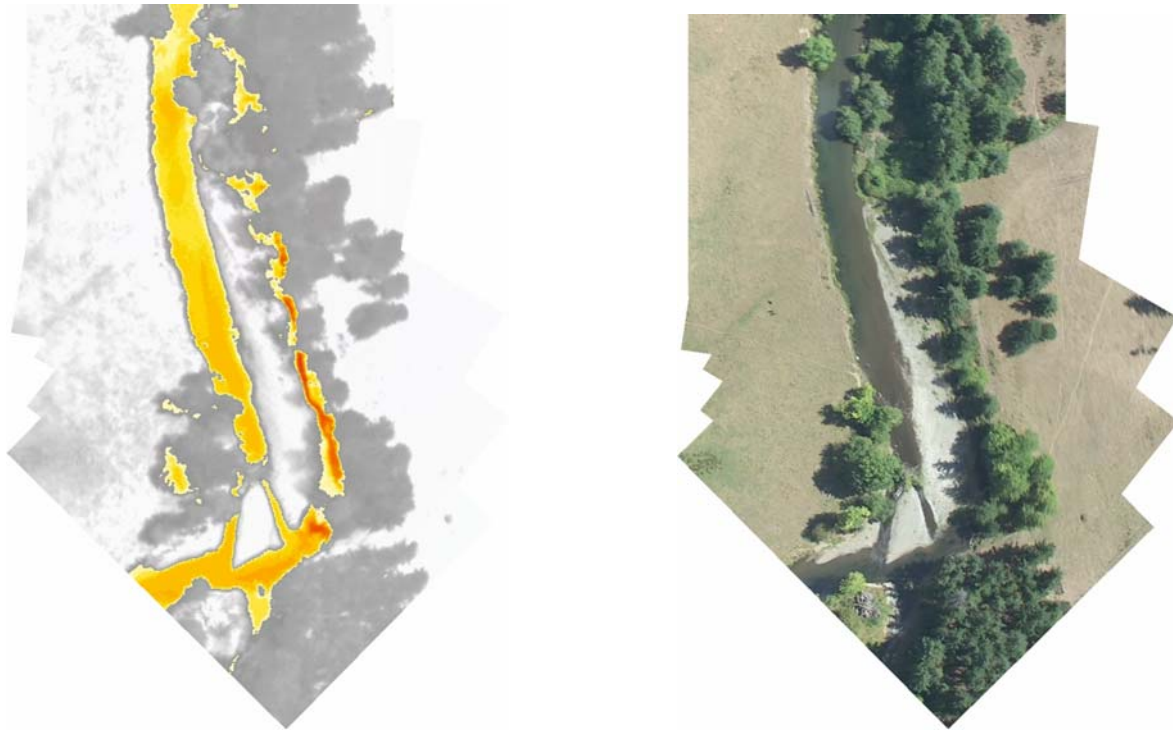


Figure 2. TIR/color video image pair showing a cool side channel (17.4°C) along the left bank of Deschutes River (19.6°C) at river mile 30.1. Flow direction is towards bottom of page.

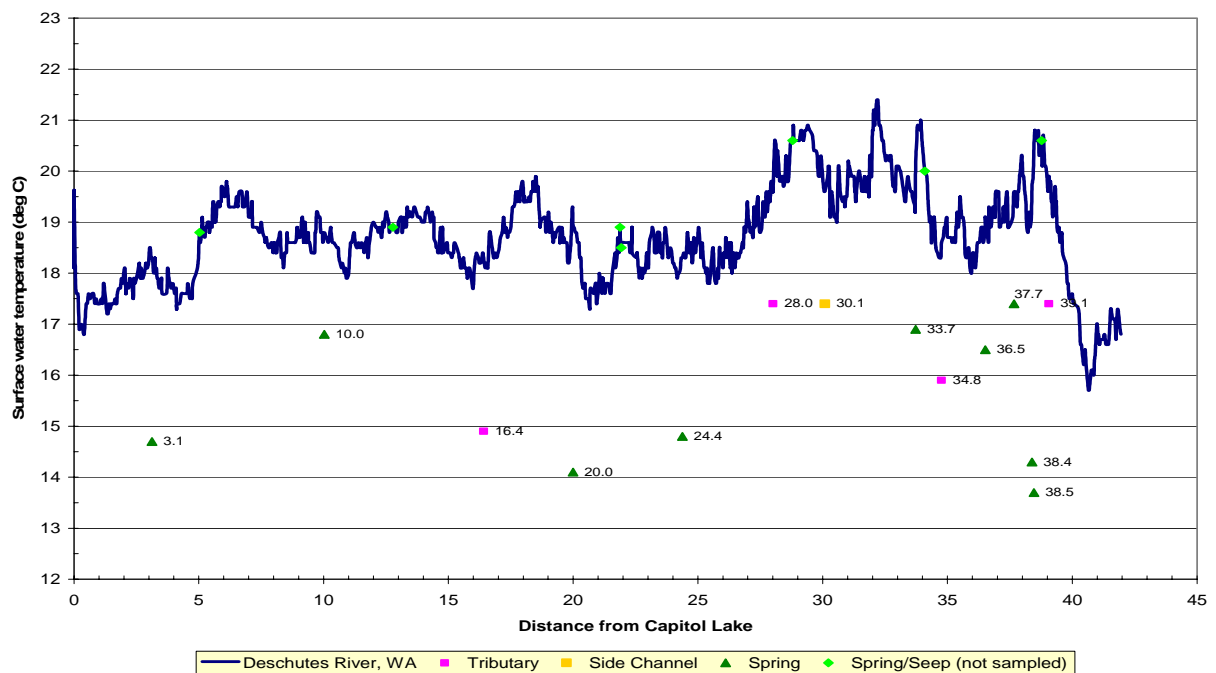


Figure 3. Longitudinal temperature profile derived from the TIR data (August 19, 2003) plotted in relation to recorded in-stream temperatures.

Table 1. Fecal coliform bacteria data to date.

Station	7/1/03	7/9/03	7/21/03	7/22/03	7/23/03	8/4/03	8/5/03	8/18/03	8/19/03	8/20/03	8/21/03	9/2/03	9/3/03	9/4/03	9/22/03	9/23/03	9/24/03	10/6/03	10/7/03	10/21/03	10/22/03	11/3/03	11/5/03	12/9/03	12/10/03
Mainstem Deschutes River																									
Deschutes at E St brg	15			12			16			28		25				23		21			180	14			7
Deschutes at Hend	19			13			11			20		22				14		13			140	5			1
Deschutes at Reichel														86			76		160		60				
Deschutes at Vail Cut												55					27		120		46		7		2
Deschutes nr Coug M												7					36								
Deschutes Tributaries																									
Ayer		20		43			27			13		34				11		290			280		32		9
Chambers		71		130			56			130		66				70		84			31		9		3
Reichel	72				40		80				56	160					51		160		210		17		13
Spurgeon		88		77			57			73		1200				120		17			46		3		7
Capitol Lake and Percival Creek Tributaries																									
Black Lk D at Belmore		11	18			28			11			22			2			1200		77		3		3	
Black Lk D nr Perc		21	43			30			26			15				18		26		320		9		3	
Percival nr mouth	37		75			43			32			100			63			27		230		3		6	
Percival nr Black Lk D		110	140			93			100			140				160		84		160		14		17	
Cap Lake at outlet												22					4		47						
Cap Lake at RR	940		2			1			1			1			1			70		420		9		16	
Budd Inlet Tributaries																									
Adams	140		21			27		69				11			52			14		880		140		28	
Butler	81		130			160		69				43			26			78		1300		11		15	
Ellis	160		96			33		90				280			14			9		700		23		9	
Indian	180		860			590		730				630			380			1000		240		120		25	
Mission	57		310			280		130				160			96			37		170		46		20	
Moxlie at East Bay	88		840			600		400				380			240			420		870		170		190	
Moxlie at Plum St						88		120				130			280			160		480		92		17	
Schneider	80		52			60		22				37			100			61		23		6		12	

Table 2. Nutrient and related laboratory data analyzed to date.

Date	Station	OP (mg/L)	TP (mg/L)	NH3N (mg/L)	NO23N (mg/L)	TPN (mg/L)	Alk (mg/L)	Hardness (mg/L)	TOC (mg/L)	DOC (mg/L)
7/1/2003	13-CAP-RR	0.017	0.035	0.041	0.131	0.365			1.6	1.6
7/1/2003	13-DES-00.5	0.021	0.026	0.024	0.764	0.981	48	47.1	1.2	1.0 U
7/1/2003	13-DES-02.7	0.022	0.025	0.019	0.782	0.922				
7/1/2003	13-DES-09.2						45	46.7		
7/1/2003	13-DES-20.5	0.017	0.021	0.019	0.871	0.985	48	47.8		
7/1/2003	13-DES-28.6						46	41.2		
7/1/2003	13-DES-37.4						41	35		
7/1/2003	13-PER-00.2	0.018	0.025	0.012	0.175	0.392				
7/24/2003	13-CAP-00.4	0.006	0.015	0.014	0.141	0.322			2	1.8
7/24/2003	13-DES-00.5	0.020	0.028	0.015	0.823	0.907	49	51.7	1.1	1
7/24/2003	13-DES-02.7	0.018	0.027	0.014	0.870	0.857				
7/24/2003	13-DES-09.2						47	53.7		
7/24/2003	13-DES-20.5	0.016	0.021	0.018	0.969	1.040	50	54.9		
7/24/2003	13-DES-28.6						45	46.9		
7/24/2003	13-DES-37.4						42	35.9		
7/24/2003	13-PER-00.1	0.018	0.029	0.010 U	0.207	0.337				
8/4/2003	13-CAP-00.4	0.010	0.027	0.010 U	0.032	0.210			2.2	2.5
8/4/2003	13-DES-00.5	0.017	0.023	0.016	0.760	0.877	51.5	53.7	1.2	1.3
8/4/2003	13-DES-02.7	0.016	0.019	0.011	0.825	0.905				
8/4/2003	13-DES-09.2						47	55.5		
8/4/2003	13-DES-20.5	0.012	0.015	0.011	0.929	1.020	50	56.6		
8/4/2003	13-DES-28.6						45	47.4		
8/4/2003	13-DES-37.4						43	36.5		
8/4/2003	13-PER-00.1	0.020	0.027	0.010 U	0.231	0.379				
8/19/2003	13-CAP-00.4	0.004	0.012	0.010 U	0.010 U	0.130			1.7	1.7
8/19/2003	13-DES-00.5	0.015	0.021	0.013	0.799	0.897	49	54.5	1.1	1
8/19/2003	13-DES-02.7	0.015	0.020	0.010 U	0.840	0.926				
8/19/2003	13-DES-09.2						47	56.9		
8/19/2003	13-DES-20.5	0.011	0.018	0.012	1.200	1.310	51.2	60.2		
8/19/2003	13-DES-28.6						46	52.2		
8/19/2003	13-DES-37.4									
8/19/2003	13-PER-00.1	0.023	0.022	0.010 U	0.300	0.395				
9/3/2003	13-CAP-00.4	0.005	0.014	0.010 U	0.010 U	0.130			2	2
9/3/2003	13-DES-00.5	0.018	0.022	0.011	0.827	0.907	50	57.8	1.4	1.3
9/3/2003	13-DES-02.7	0.019	0.022	0.010	0.857	0.942				
9/3/2003	13-DES-09.2						46	60.5		
9/3/2003	13-DES-20.5	0.016	0.018	0.010 U	1.120	1.200	50.9	64.1		
9/3/2003	13-DES-28.6						46	54		
9/3/2003	13-DES-37.4						43	40.2		
9/3/2003	13-PER-00.1	0.026	0.029	0.010 U	0.343	0.415				
9/22/2003	13-CAP-00.4	0.008	0.020	0.010 U	0.010 U	0.160			1.8	1.9
9/22/2003	13-DES-00.5	0.016	0.021	0.011	0.799	0.889	50	55.4	1.0 U	1.0 U
9/22/2003	13-DES-02.7	0.016	0.018	0.010 U	0.847	0.887				
9/22/2003	13-DES-09.2						46	57.4		
9/22/2003	13-DES-20.5	0.008	0.012	0.010 U	0.582	0.664	48	57.5		
9/22/2003	13-DES-28.6						45	49.8		
9/22/2003	13-DES-37.4						44	38.7		

9/22/2003	13-PER-00.1	0.023	0.026	0.010 U	0.326	0.428				
10/7/2003	13-CAP-00.4	0.010	0.024	0.015	0.265	0.428			1.4	1.3
10/7/2003	13-DES-00.5	0.021	0.028	0.017	0.866	0.989	50	55.9	1.0 U	1.0 U
10/7/2003	13-DES-02.7	0.021	0.025	0.015	0.904	1.020				
10/7/2003	13-DES-09.2						46	57.1		
10/7/2003	13-DES-20.5	0.012	0.018	0.014	0.562	0.692	47	55.8		
10/7/2003	13-DES-28.6						44	49.8		
10/7/2003	13-DES-37.4						45	38.7		
10/7/2003	13-PER-00.1	0.021	0.030	0.010 U	0.231	0.417				
10/22/2003	13-CAP-00.4	0.021	0.042	0.037	0.508	0.788			5.5	4.8
10/22/2003	13-DES-00.5	0.014	0.028	0.013	0.582	0.735	26.3	29.2	4.5	4
10/22/2003	13-DES-02.7	0.013	0.027	0.024	0.571	0.722				
10/22/2003	13-DES-09.2						25.4	28		
10/22/2003	13-DES-20.5	0.009	0.018	0.010 U	0.444	0.516	25.2	26.5		
10/22/2003	13-DES-28.6						25.3	25		
10/22/2003	13-DES-37.4						23.8	22.3		
10/22/2003	13-PER-00.1	0.015	0.042	0.020	0.445	0.778				
11/3/2003	13-CAP-00.4	0.012	0.025	0.018	0.263	0.484			4.3	3.9
11/3/2003	13-DES-00.5	0.014	0.022	0.010 U	0.660	0.784	43.9	46.5	1.6	1.4
11/3/2003	13-DES-02.7	0.014	0.020	0.010 U	0.670	0.809				
11/3/2003	13-DES-09.2						41.1	45.9		
11/3/2003	13-DES-20.5	0.010	0.011	0.010 U	0.336	0.426	40.1	40.6		
11/3/2003	13-DES-28.6						37.7	35.5		
11/3/2003	13-DES-37.4						34.1	28.6		
11/3/2003	13-PER-00.1	0.008	0.022	0.021	0.116	0.407				
12/9/2003	13-CAP-00.4	0.016	0.021	0.018	0.473	0.626			3.2	2.7
12/9/2003	13-DES-00.5	0.015	0.019	0.010 U	0.559	0.694	30.4	32.2	2.5	2
12/9/2003	13-DES-02.7	0.015	0.018	0.010 U	0.559	0.691				
12/9/2003	13-DES-09.2						28.1	30.1		
12/9/2003	13-DES-20.5	0.013	0.015	0.010 U	0.423	0.531	27.3	27		
12/9/2003	13-DES-28.6						25.5	34.5		
12/9/2003	13-DES-37.4						23.5	21		
12/9/2003	13-PER-00.1	0.010	0.019	0.012	0.216	0.430				

Table 3. *In situ* dissolved oxygen and pH results to date.

DO data 7/1/03 – 9/3/03	7/1/03	7/2/03	7/9/03	7/21/03	7/22/03	7/23/03	7/24/03	8/4/03	8/5/03	8/18/03	8/19/03	8/20/03	8/21/03	9/2/03	9/3/03
Adams															
Ayer			3.15		2.08				2.24			2.15		3.46	
Black Lake Ditch at Belmore			9	8.53				8.7			8.7			7.6	
Black Lake Ditch nr Percival			7.84	7.58				8.1						8.79	
Capitol Lake at RR	9.75			10.02				10.74			11.7			12.5	
Deschutes at E St brg	9.6				9.3				9.3			8.6		10.26	
Deschutes at Henderson	9.29				9.03				9.3			9.1		10.32	
Huckleberry		9.3					8.7		8.81						8.72

Lake Lawrence Trib															2.5
Percival nr Black Lk D											8.42				
Percival nr mouth	8.78			8.35				9.03			9.02			9.4	
Reichel	7.75					5.25			5.2				5		6.1

DO data 9/22/03 - 12/10/03	9/22/03	9/23/03	9/24/03	9/25/03	10/6/03	10/7/03	10/21/03	10/22/03	10/23/03	11/3/03	11/5/03	12/9/03	12/10/03
Adams													
Ayer		3.5			1.11			1.4			6.51		4.35
Black Lake Ditch at Belmore	8.5				8.35		8			8.95		8.45	
Black Lake Ditch nr Percival		8.9					8.4					10.38	
Capitol Lake at RR	14.42				9.5		9			11.18		11.6	
Deschutes at E St brg		9.8			10.1			8.92					11.01
Deschutes at Henderson		9.9			9.83			8.92		11.5			
Huckleberry				9.4		9.2			9.72				
Lake Lawrence Trib			2.75			2.39							
Percival nr Black Lk D					8.64								
Percival nr mouth	9.35				9.3		9.2					11.4	
Reichel			6.55			5.4		4.3			9.45		9.48

pH data 7/1/03 – 9/3/03	7/1/03	7/2/03	7/9/03	7/21/03	7/22/03	7/23/03	7/24/03	8/4/03	8/5/03	8/18/03	8/19/03	8/20/03	8/21/03	9/2/03	9/3/03
Adams	6.8			7.18				6.95		6.85				7.08	
Ayer			6.6		6.45				6.66			6.7		6.58	
Black Lake Ditch at Belmore			7.75	7.6				8.12			7.6			7.03	
Black Lake Ditch nr Percival			7.26	7.4				7.5			7.44			7.44	
Butler	7.84			7.83				7.95		7.66				7.85	
Chambers			7.45		7.42				7.95			7.5		7.41	
Deschutes at 1000 Rd		7.97					8.16		8.02						8.38
Deschutes at E St brg	7.45				7.43				7.5			7.4		7.6	
Deschutes at Henderson	7.32				7.43				7.44			7.31		7.53	
Deschutes at Rte 507	7.61					7.55			7.72			7.69			7.8
Deschutes at Vail Cutoff	7.5					7.2			7.05				7.05		7.09
Deschutes nr Rich Rd	7.6				7.44				7.47			7.51		7.8	
Ellis	7.67			7.43				7.61		7.36				7.49	
Hard		7.64					7.4		7.67						7.53
Huckleberry		7.36					7.49		7.4						7.55
Indian				7.61											
Lake Lawrence Trib															6.52
Lincoln		7.83					7.72		7.86						7.95
Little Deschutes		7.92					7.95		7.93						8.01

Mission														7.7	
Moxlie at East Bay				7.7											
Moxlie at Plum	7.53							7.61		7.54				7.63	
Percival nr Black Lk D			7.56	7.55				7.68			7.6				
Percival nr mouth	7.55			7.48				7.62			7.59			7.7	
Reichel	7.07					6.95			6.96				7.15		7.3
Schneider	7.58			7.53				7.75		7.51				7.61	
Spurgeon			7.65		7.52				7.47			7.56		7.62	
Thurston		7.67					7.79		8.02						7.85

pH data 9/22/03 – 12/10/03	9/22/03	9/23/03	9/24/03	9/25/03	10/6/03	10/7/03	10/21/03	10/22/03	10/23/03	11/3/03	11/5/03	12/9/03	12/10/03
Adams	7.55				6.94		6.18			6.95		6.25	
Ayer		6.9			6.65			6.37			6.79		6.95
Black Lake Ditch at Belmore	7.73				7.64		7.36			7.31		7.38	
Black Lake Ditch nr Percival		7.47			7.39		6.68			7.06		7.1	
Butler	7.81				7.9		7.24			7.36		7.35	
Chambers		7.48			7.58			6.89			7.56		7.07
Deschutes at 1000 Rd			7.97			8.21		7.52			7.71		7.61
Deschutes at E St brg		7.69			7.58			6.9		7.25			7.38
Deschutes at Henderson		7.48			7.48			6.98		7.25			7.39
Deschutes at Rte 507			8			7.76		7.36			7.57		7.62
Deschutes at Vail Cutoff			7.62			7.36		7.3			7.36		7.42
Deschutes nr Rich Rd		7.62			7.79			6.95			7.43		7.08
Ellis	7.78				7.49		6.74			7.34		7.55	
Hard			8.05			7.5			7.45				
Huckleberry				7.65		7.58			7.37				
Indian												7.08	
Lake Lawrence Trib			6.6			6.62							
Lincoln			8.1			7.87			7.61				
Little Deschutes			7.9			7.96			7.69				
Mission													
Moxlie at East Bay													
Moxlie at Plum	7.78				7.55		6.96			7.35		7.27	
Percival nr Black Lk D													
Percival nr mouth	7.63				7.6		6.97			7.36		7.3	
Reichel			7.55			7.33		6.37			6.82		6.88
Schneider	7.67				7.67		7.16			7.47		7.42	
Spurgeon		7.41			7.66			6.56			7.34		7
Thurston			7.79			7.83			7.57				

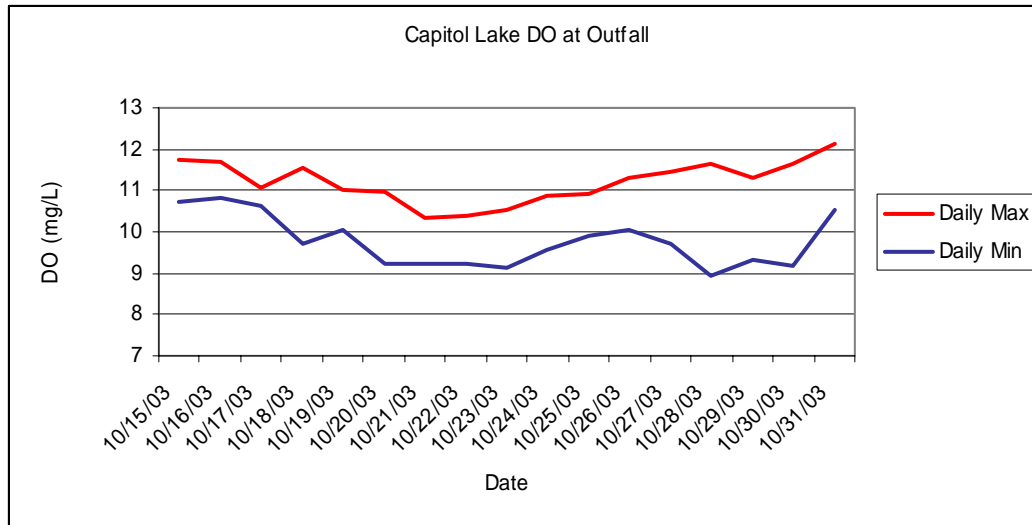


Figure 4. Dissolved oxygen levels at the outlet from Capitol Lake

Table 4. Dry weather stormwater outfall information collected October 14, 2003.

Site	F.C.	Entity	Receiving Water Body	System Name	Total Basin Area (ac)
13-CPL-OUTF	Dry	Olympia	Capitol Lake	7th Avenue outfall	25
13-AUT-OUTF	19	Olympia	Percival Creek	Automall outfall	145
13-BLM-OUTF	Dry	Olympia	Black Lake Ditch	Black Lake Meadows	775
13-GIL-OUTF	Dry	Olympia	Schneider Creek	Giles Ave outfall	215
13-SCH-OUTF	28	Olympia	Schneider Creek	Elliott and Milroy outfall	45
13-IND-OUTF	Dry	Olympia	Indian Creek	Pacific Avenue outfall	20
13-MOX-OUTF	23	Olympia	Moxlie Creek	State Avenue outfall	235
13-MIS-OUTF	Dry	Olympia	Mission Creek	Roosevelt and Yew outfall	30
13-MST-OUTF	Dry	Tumwater	Deschutes River	M Street	257
13-LST-OUTF	Dry	Tumwater	Deschutes River	Linda Street	